

## **Title: Tantalizing Tangrams**

### **Brief Overview:**

In this unit, students will develop spatial-visualization skills by identifying geometric figures in tangrams. Students will investigate attributes of symmetry, congruency, and similarity as they create various shapes and figures with tangrams and then incorporate them into a story.

### **NCTM 2000 Principles for School Mathematics:**

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

### **Links to NCTM 2000 Standards:**

- **Content Standards**

- **Number and Operations**

- *Understand numbers, ways of representing numbers, relationships among numbers, and number systems; recognize equivalent representations for the same number and generate them by decomposing and composing numbers; develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers; use models, benchmarks, and equivalent forms to judge the size of fractions; and recognize and generate equivalent forms of commonly used fractions, decimals, and percents.*
    - *Understand meaning of operations and how they relate to one another; understand various meanings of multiplication and division; and understand the effects of multiplying and dividing whole numbers.*
    - *Compute fluently and make reasonable estimates; develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students'*

*experience; and select appropriate methods and tools for computing with whole numbers from among mental computation, estimate, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.*

### **Algebra**

- *Understand patterns, relations, and functions; and represent and analyze patterns and functions, using words, tables, and graphs.*
- *Use mathematical models to represent and understand quantitative relationships; and model problem situations with objects and use presentations such as graphs, tables, and equations to draw conclusions.*
- *Analyze change in various contexts; investigate how a change in one variable relates to a change in a second variable; and identify and describe situations with constant or varying rate of change and compare them.*

### **Geometry**

- *Analyze characteristics and properties of two-and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships; identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes; classify two-and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids; investigate, describe, and reason about the results of subdividing, combining, and transforming shapes; explore congruence and similarity; and make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.*
- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems; describe location and movement using common language and geometric vocabulary; make and use coordinate systems to specify locations and to describe paths; and find the distance between points along horizontal and vertical lines of a coordinate system.*
- *Apply transformations and use symmetry to analyze mathematical situations; predict and describe the results of sliding, flipping, and turning two-dimensional shapes; describe a motion or a series of motions that will show that two shapes are congruent; and identify and describe line and rotational symmetry in two- and three- dimensional shapes and designs.*
- *Use visualizations, spatial reasoning, and geometric modeling to solve problems; build and draw geometric objects; create and describe mental images of objects, patterns, and paths; identify and build a three-dimensional object from two-dimensional presentations of that object; identify and draw a two-dimensional representation of a three-dimensional objects; use geometric models to solve problems in other areas of mathematics, such as number and measurement; and recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.*

### **Measurement**

- *Understand measurable attributes of objects and the units, systems, and processes of measurement; understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute; understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems; carry out simple unit conversions, such as from centimeters to meters,*

*within a system of measurement; understand that measurements are approximate and how differences in units affect precision; and explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.*

- *Apply appropriate techniques, tools, and formulas to determine measurements, develop strategies for estimating the perimeters, areas, and volumes of irregular shapes; select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles; and select and use benchmarks to estimate measurements.*

## • **Process Standards**

### **Problem Solving**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical problem solving.*

### **Reasoning and Proof**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize reasoning and proof as fundamental aspects of mathematics; make and investigate mathematical conjectures; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof.*

### **Communication**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; and the language of mathematics to express mathematical ideas precisely.*

### **Connections**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in context outside of mathematics.*

### **Representation**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social, and mathematical phenomena.*

**Grade/Level:**

Grades 3-5.

**Duration/Length:**

This unit will take approximately three periods. Also included are extension activities.

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Recognition of basic shapes i.e., triangle, right triangle, square, rectangle, parallelogram (As appropriate: hexagon, pentagon, and trapezoid)
- Knowledge of congruence, similarity, and symmetry
- Knowledge of terms *greater than* / *less than*
- Experience with writing to express personal ideas

**Student Outcomes:**

Students will:

- Identify attributes of geometric shapes
- Compare geometric shapes
- Create characters for a story using tangrams
- Write a story incorporating the tangram pieces

**Materials/Resources/Printed Materials:**

- One tangram puzzle for each student, pre-made or cut from cardstock
- The book, Grandfather Tang's Story
- Teacher Resource Sheets # 1-5
- Student Resource Sheets # 1-5
- Lined Writing Paper
- Pencils, markers, glue sticks

**Development/Procedures:****Lesson 1:*****Motivation:***

- Explain the following performance assessment task to be completed at the end of the unit. A publishing company is having a contest asking students to write a story. Students need to design tangram shapes to represent characters in their story. Students will incorporate tangram character shapes into their story.

- Hand out tangrams. Teacher tells students that there is a problem to solve. She or he has the seven geometric shapes in front of them. All seven shapes must fit together to form a square.
- Students spend time manipulating the shapes.
- After a few minutes, teacher begins to give clues one at a time:
  1. Hand out activity sheet with the size of the square outlined. Tell students the pieces must fit inside the square (Student Resource Sheet # 1).
  2. Place pieces of the tangram on the square, adding additional pieces until the solution is found.
- After all clues have been given, teacher will share solution (Teacher Resource Sheet #1). (tangram pieces can be displayed on the overhead, or on the board with cutout shapes made from cardstock. \*For constructing your own set of tangrams, refer to website: <http://mathforum.org/trscavo/tangrams/construct.html> )

#### ***Activities:***

- As a class, identify the shapes in the tangram. Label shapes. (Suggestion: keep labeled shapes displayed for the duration of the unit.) Discuss their similarities, congruency and lines of symmetry.
- As a class, read and discuss the history of tangrams (Student Resource Sheet # 2).
- Explore tangrams by manipulating tangrams into simple geometric shapes (transparency of Teacher Resource Sheet # 2).
- Students create additional geometric shapes (transparency of Teacher Resource Sheet # 3).

#### ***Assessment:***

- Students will complete a journal activity defining tangrams using the following three terms: **geometric figures, tangrams, and seven.**
- Journal Prompt: *“Define tangrams using the following three terms: geometric figures, tangrams, seven.”*

### **Lesson 2:**

#### ***Motivation:***

- Activate prior knowledge by identifying the shapes and their attributes in a tangram (Student Resource Sheet #3).

#### ***Activities:***

- Read Aloud: Grandfather Tang’s Story.  
On the overhead, display tangram figures as they appear in the story (Teacher may create on their own).
- Students create character shapes following models displayed on overhead (Teacher Resource Sheets #4 A - 4J).

#### ***Assessment:***

- Independently, students create 3-5 shapes that represent characters they will use in the story they will be writing for the summative assessment. Students will save character shapes to incorporate into the story that will be created in lesson three. \*As

an extension activity, teacher could lead students to participate in a gallery walk to observe peer creations.

### **Lesson 3:**

#### ***Motivation:***

- Activate prior knowledge by having students manipulate tangram pieces to complete activity. This activity will assess students' understanding of area. (Resource Sheets 4A and 4B). Students will use the symbols for greater than, less than, and equal to compare the area of the tangrams.

#### ***Activities:***

- Review and discuss the plot and characters of Grandfather Tang's Story.
- Present and discuss criteria for performance assessment activity (Teacher Resource Sheet #5).  
\*Early finishers could visit an interactive web site to solve tangram puzzles:  
<http://www.tangram.i-p.com/>

#### ***Performance Assessment:***

- Students independently complete performance assessment activity.

### **Performance Assessment:**

A publishing company is having a contest asking students to write a story. Students need to design tangram shapes to represent characters in their story. Students incorporate tangram character shapes into their story.

### **Extension/Follow Up:**

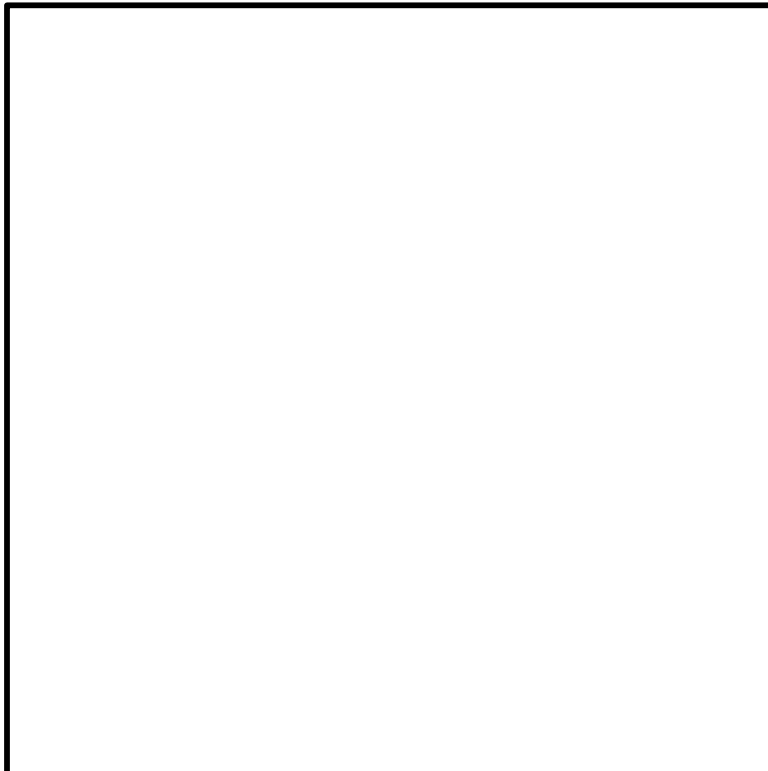
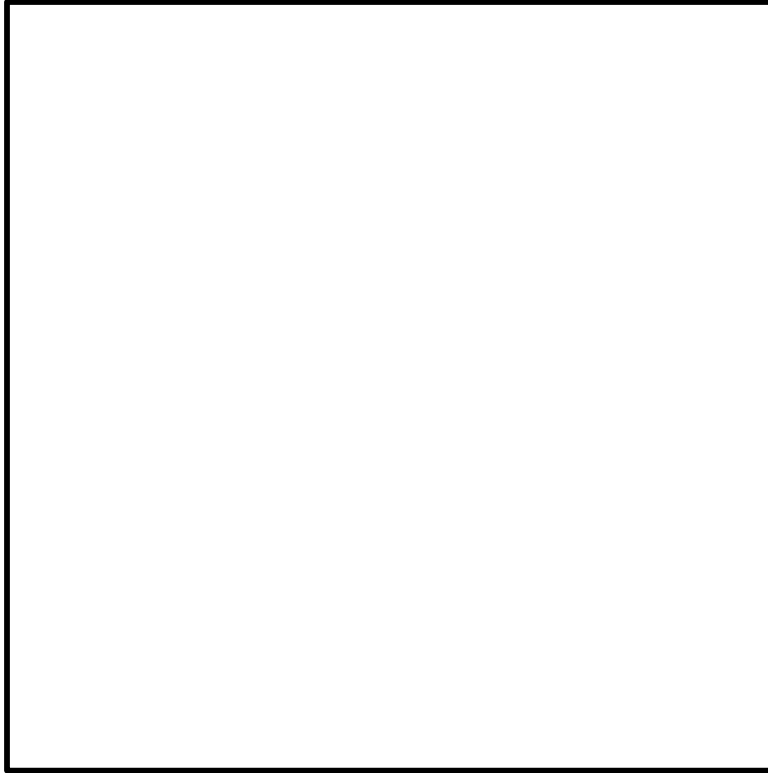
- For constructing your own set of tangrams, refer to website: <http://mathforum.org/trscavo/tangrams/construct.html>
- \*Early finishers could visit an interactive web site to solve tangram puzzles. Refer to website: <http://www.tangram.i-p.com/>
- As an extension activity, teacher could lead students to participate in a gallery walk to observe peer creations.
- Supplemental book for younger grades: Three Pigs, One Wolf, And Seven Magic Stars.
- Additional information may be obtained from the International Tangram Society: <http://www.support@stargraphics.com>

### **Authors:**

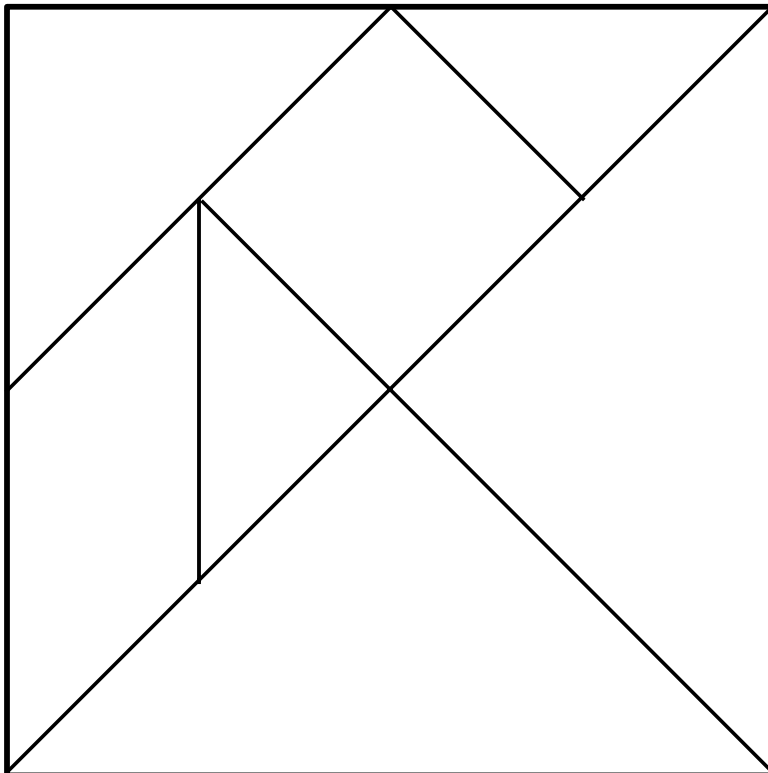
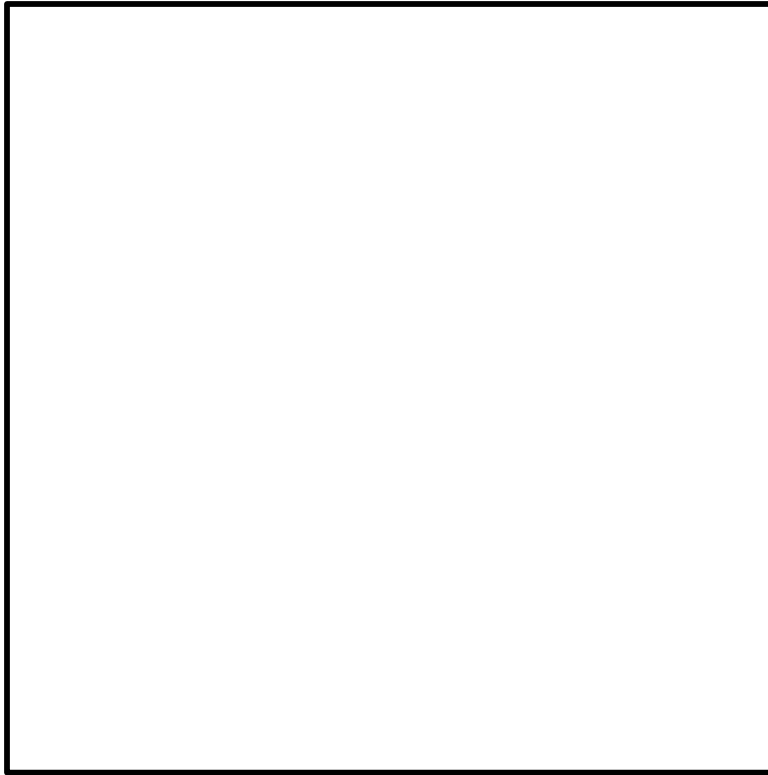
Tricia Rueter  
Cromwell Valley Elementary School  
Baltimore County

Robin Rohrbaugh  
Baltimore Highlands Elementary School  
Baltimore County

***\*Get Tantalized with Tangrams!!***

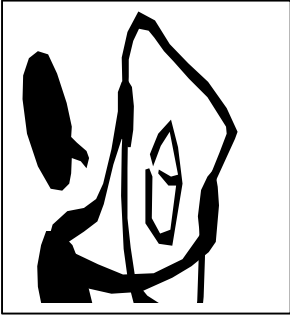


## ***Get Tantalized with Tangrams!!***





# HISTORY OF TANGRAMS



The tangram is a puzzle game that originated in China many years ago. There are many theories (ideas) about when this puzzle was created. Some people say it was created about 200 years ago, while others believe it was created as many as 4000 years ago!

Wow!

The tangram consists of **seven** geometric pieces called "tans." All seven pieces were designed to fit together to form a square.

The seven-tangram pieces are:

- 2 large right triangles
- 1 medium right triangle
- 2 small right triangles
- 1 medium square
- 1 parallelogram

These seven geometric pieces can be moved around to form hundreds of shapes.

The tangram has an interesting name too! Again, there have been many theories as to how it got its name. Some people believe it was named for Tan, a famous Chinese scholar. Others believe it was named after the tanka, Chinese families who lived on riverboats. Still others think tangrams were named after the Tang dynasty, who were people that ruled China from 618-907 A.D. That was approximately 3000 years ago!

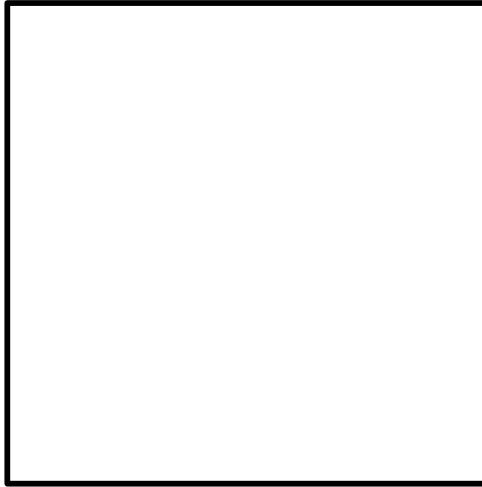
There are many interesting facts and theories about the history of tangrams. The most interesting one of all is that even after all these years they are still a source of amazement and enjoyment.

# Let's Create Simple Geometric Shapes With Tangram Pieces

use 2-4 Tangram pieces to create these shapes.



Small Square



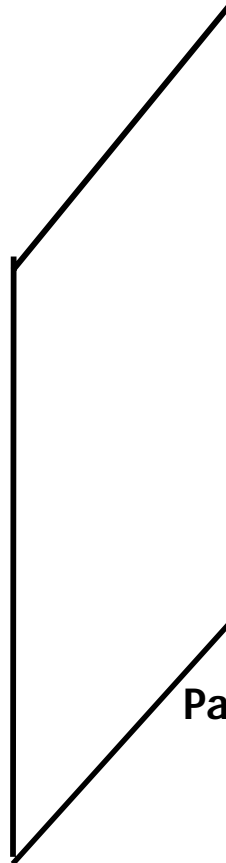
Large Square



Rectangle



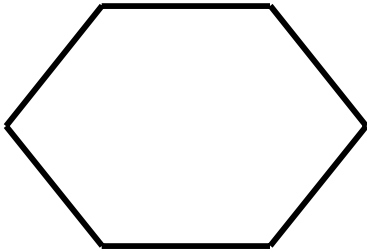
Trapezoid



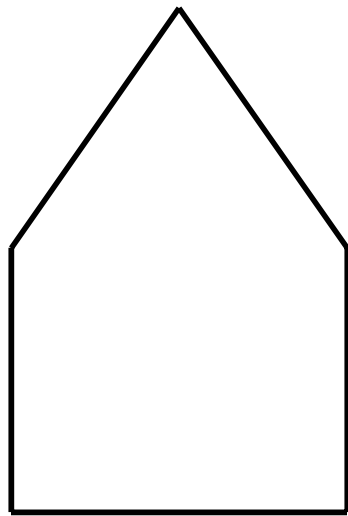
Parallelogram

# Let's Create Simple Geometric Shapes With Tangram Pieces

use 2-4 Tangram pieces to create these shapes.



Hexagon

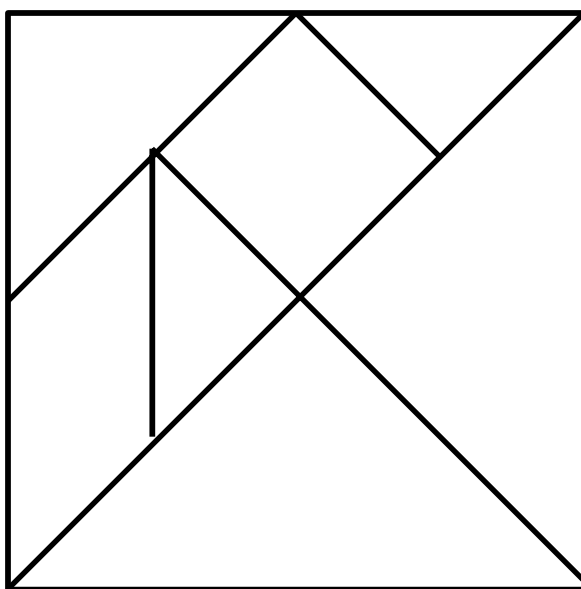


Pentagon

# Tantalizing Tangrams

## Read to Perform a Task

**Directions:** Use your tangrams to make the following shapes.



- ❖ A long rectangle
- ❖ A different long rectangle
- ❖ A large parallelogram
- ❖ A larger triangle
- ❖ A six-sided shape
- ❖ An animal or design of your choosing

Use your tangram to create the following:

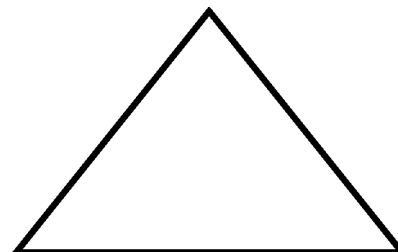
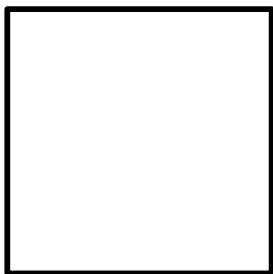
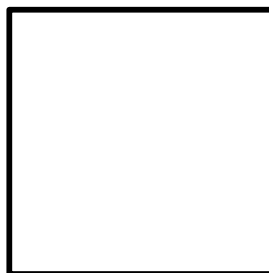
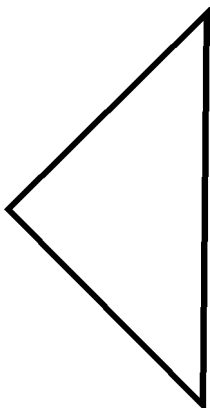
**Desk Top**  
**Ceiling Vent**  
**Boat Sails**  
**TV Screen**  
**Kite**  
**Arrow**  
**Door**  
**Blackboard**



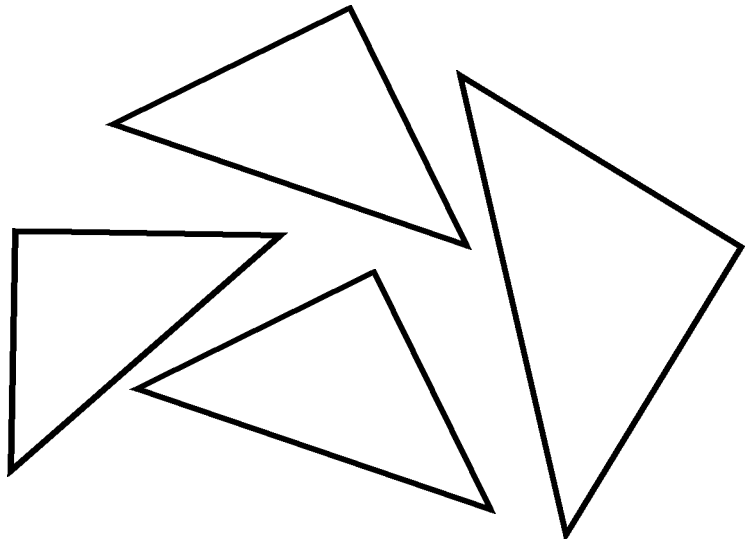
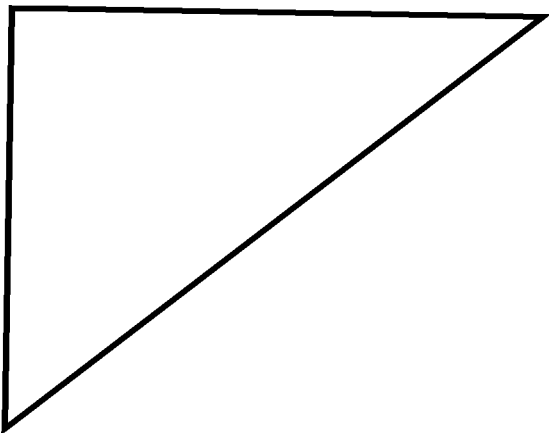
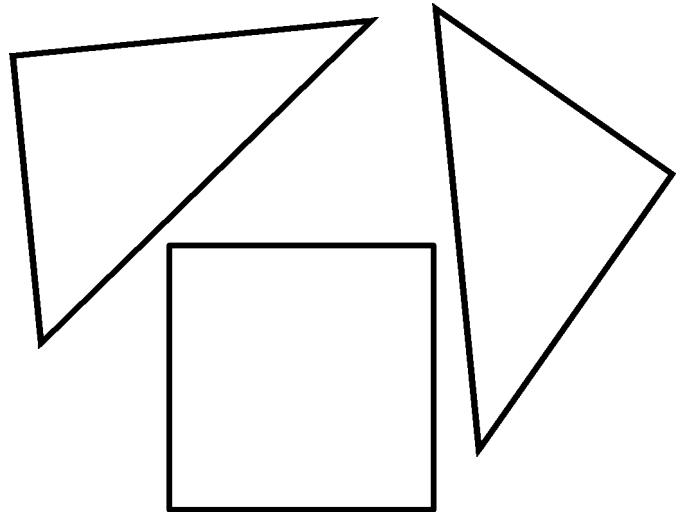
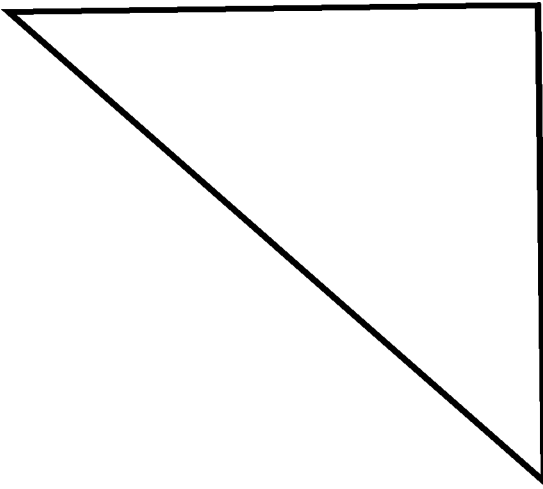
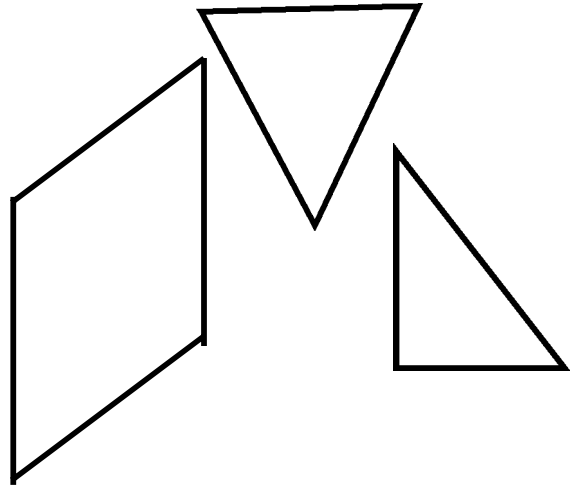
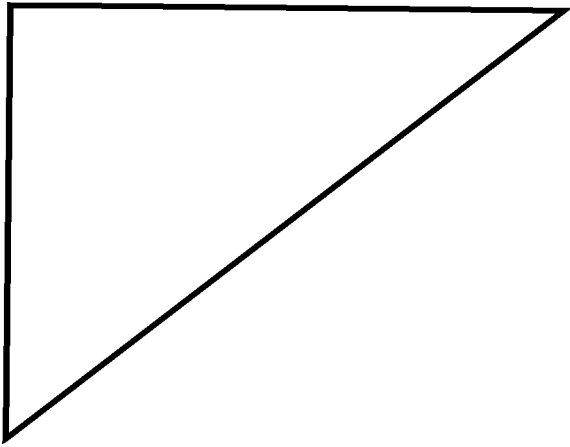
Name \_\_\_\_\_ Date \_\_\_\_\_

Directions: Evaluate the area of the following geometric figures.

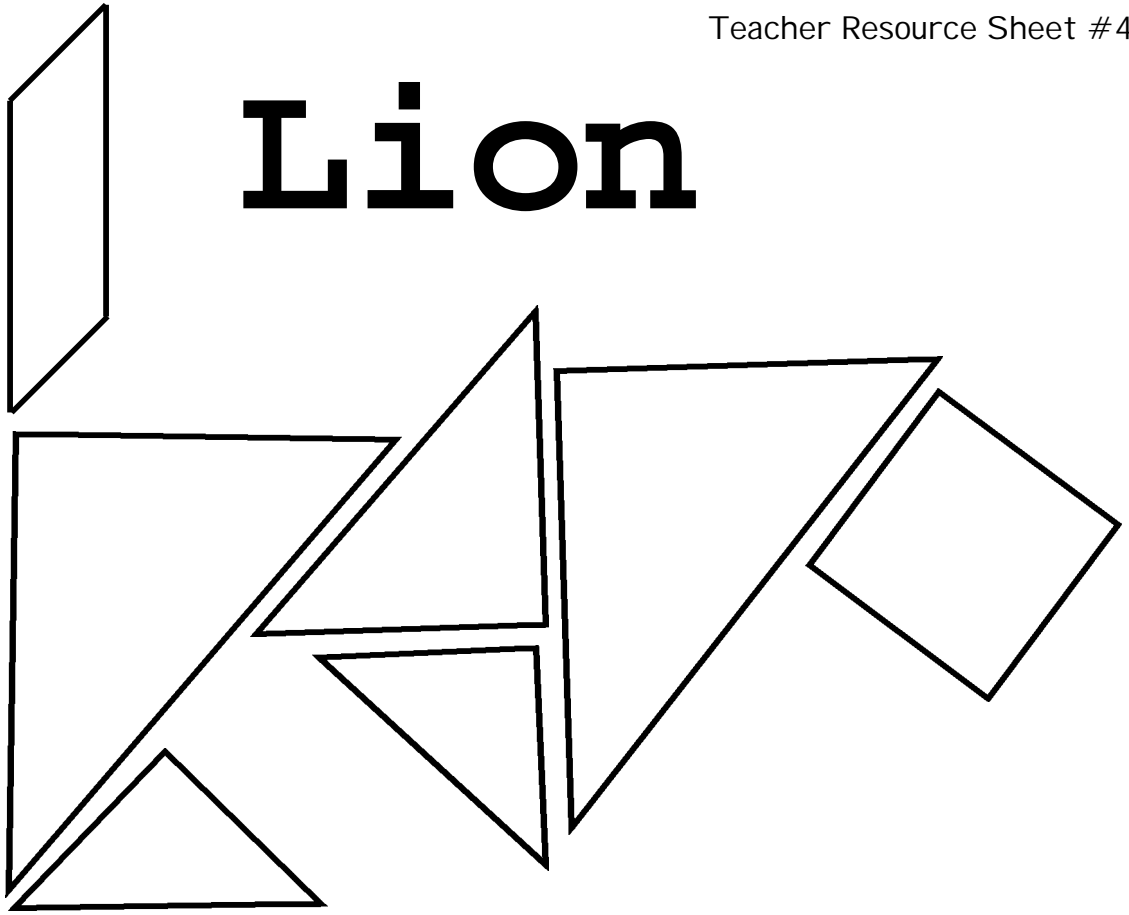
Afterwards, put  $<$  ,  $>$  or  $=$  Between the shapes.



Student Resource Sheet #4B

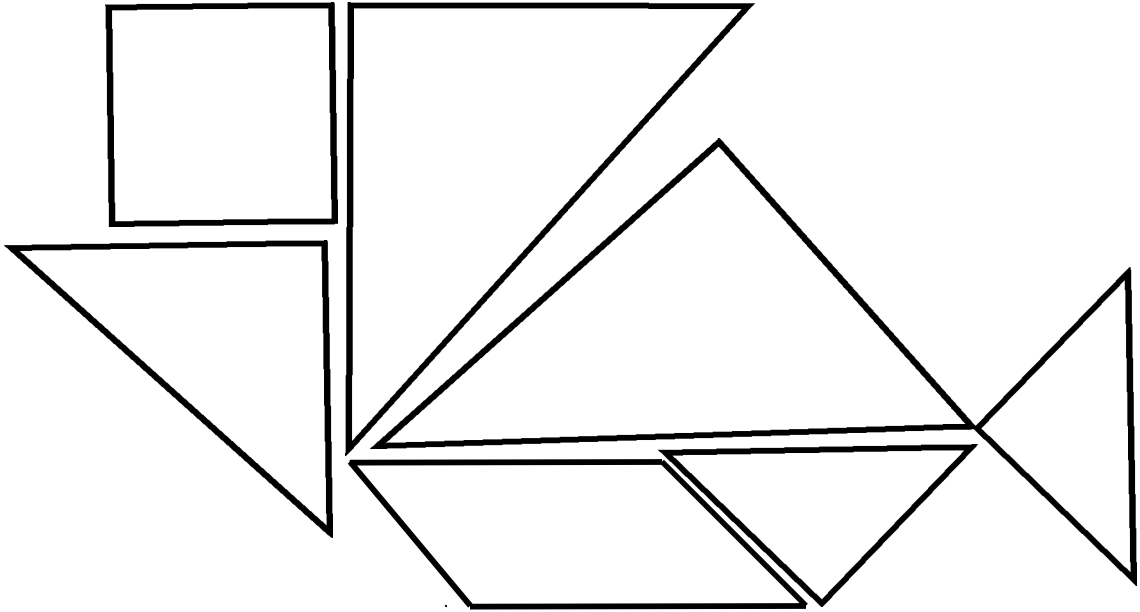


# Lion

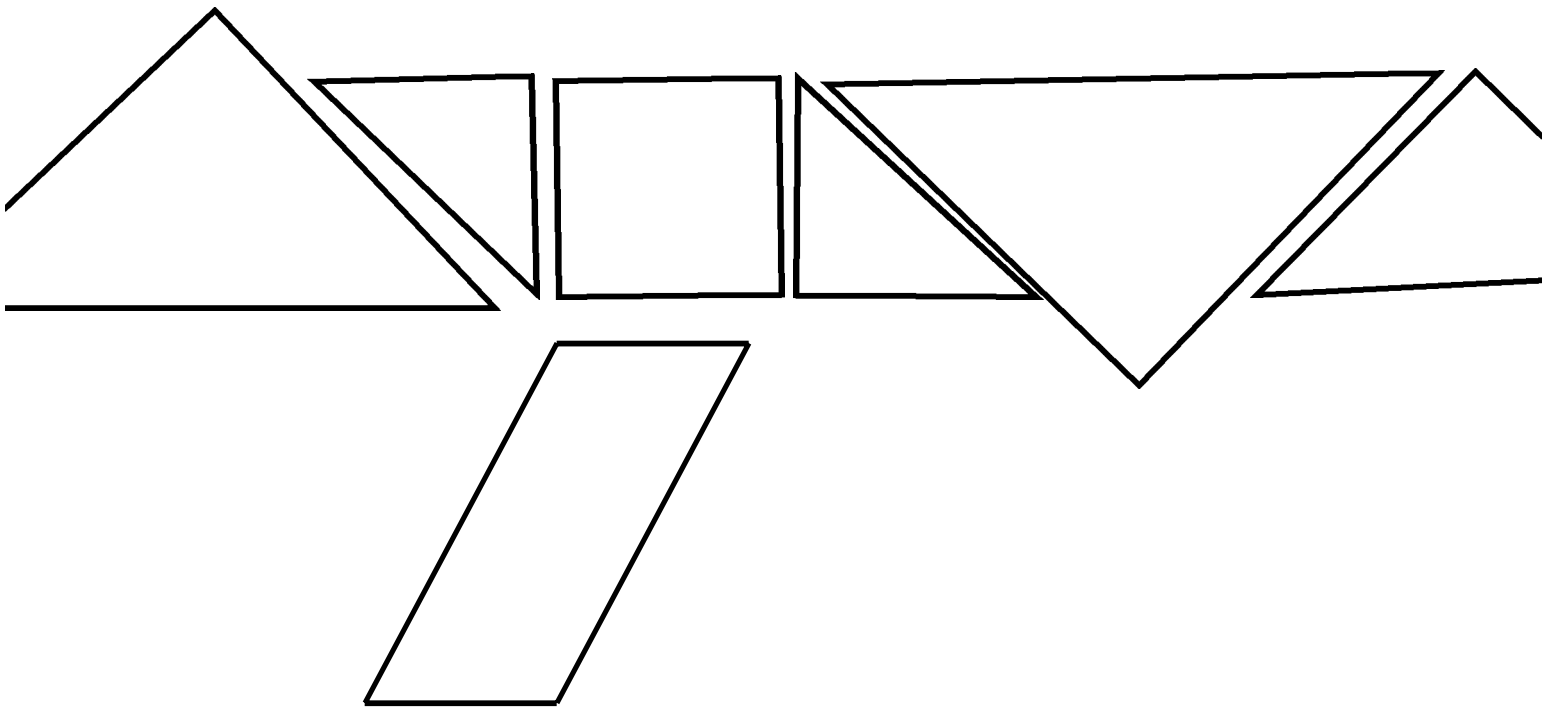




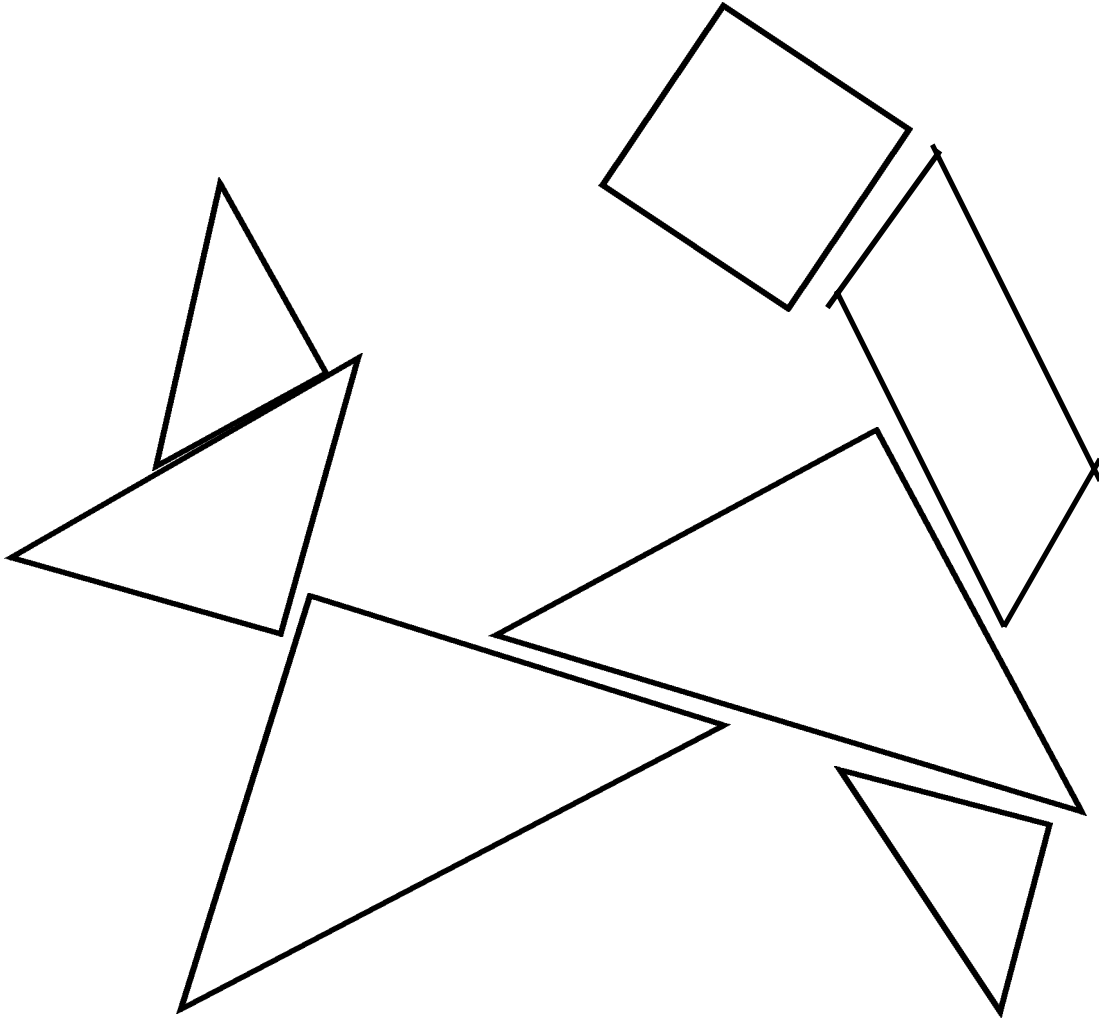
# Goldfish



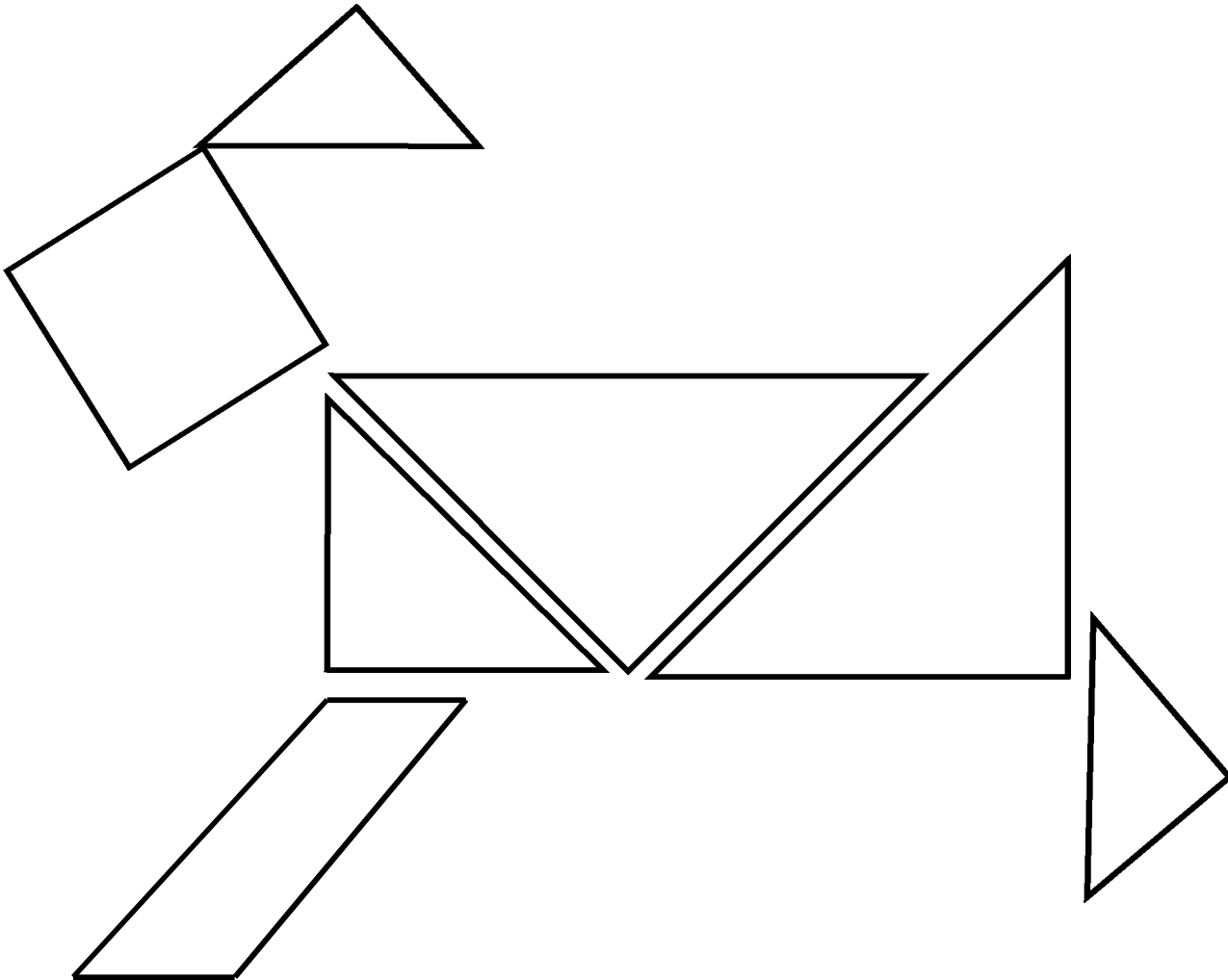
# Crocodile



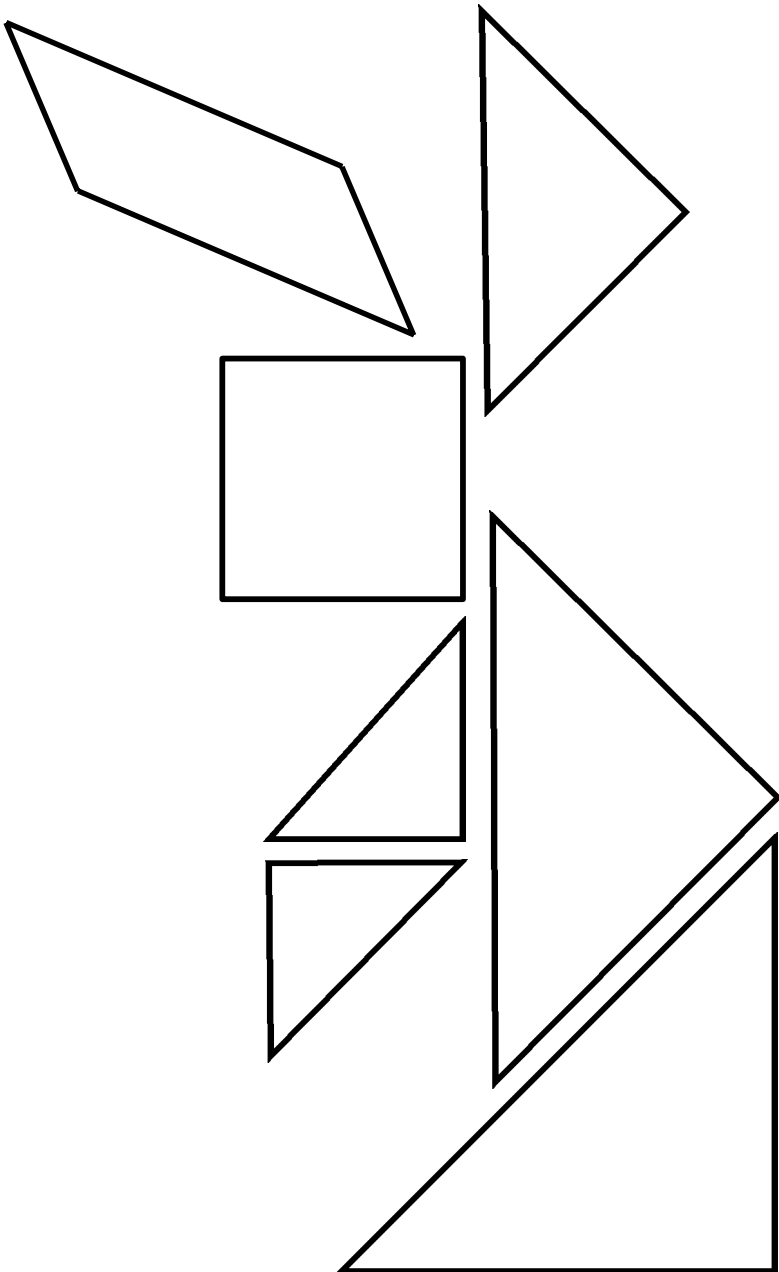
# Squirrel



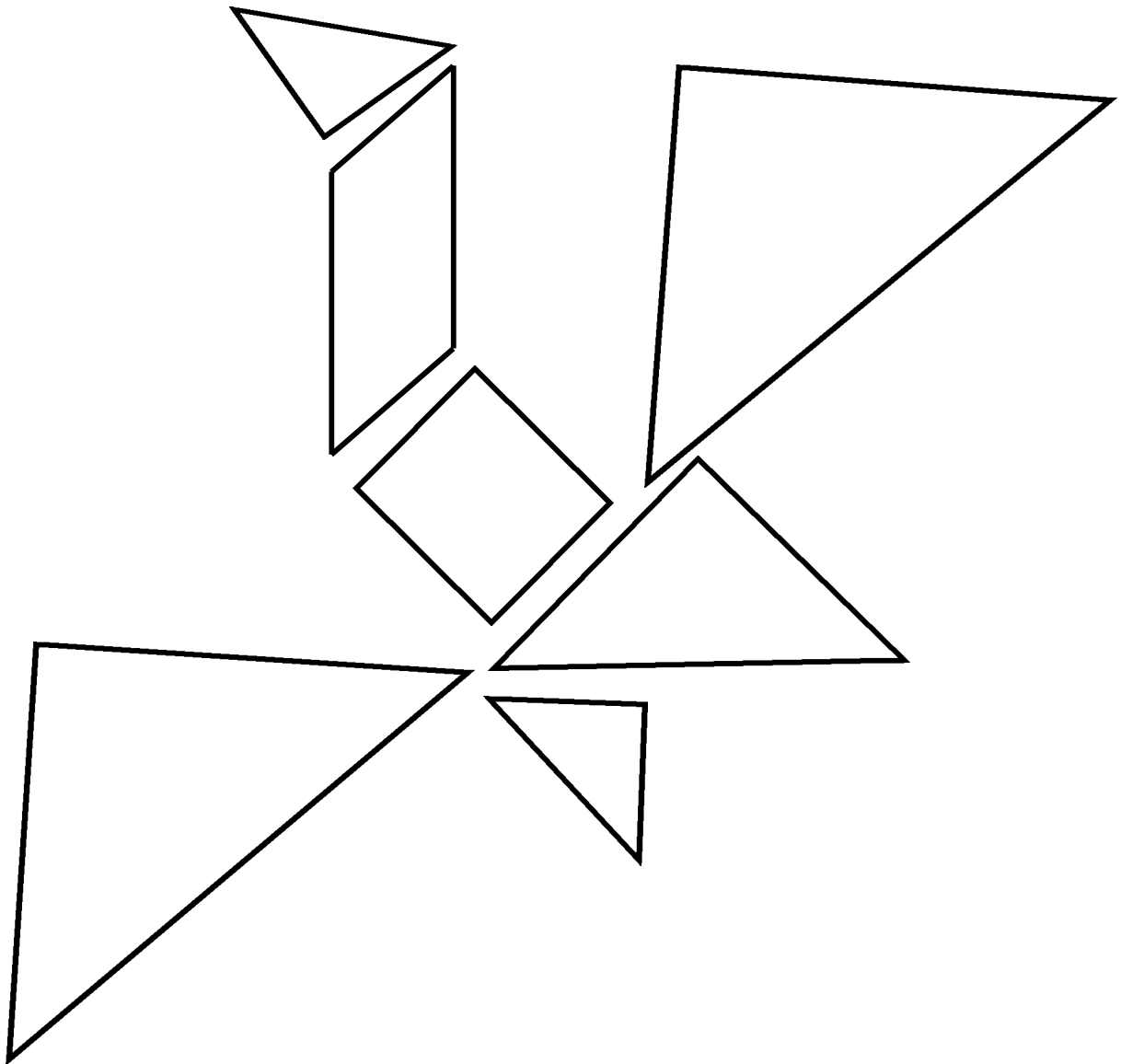
# Dog

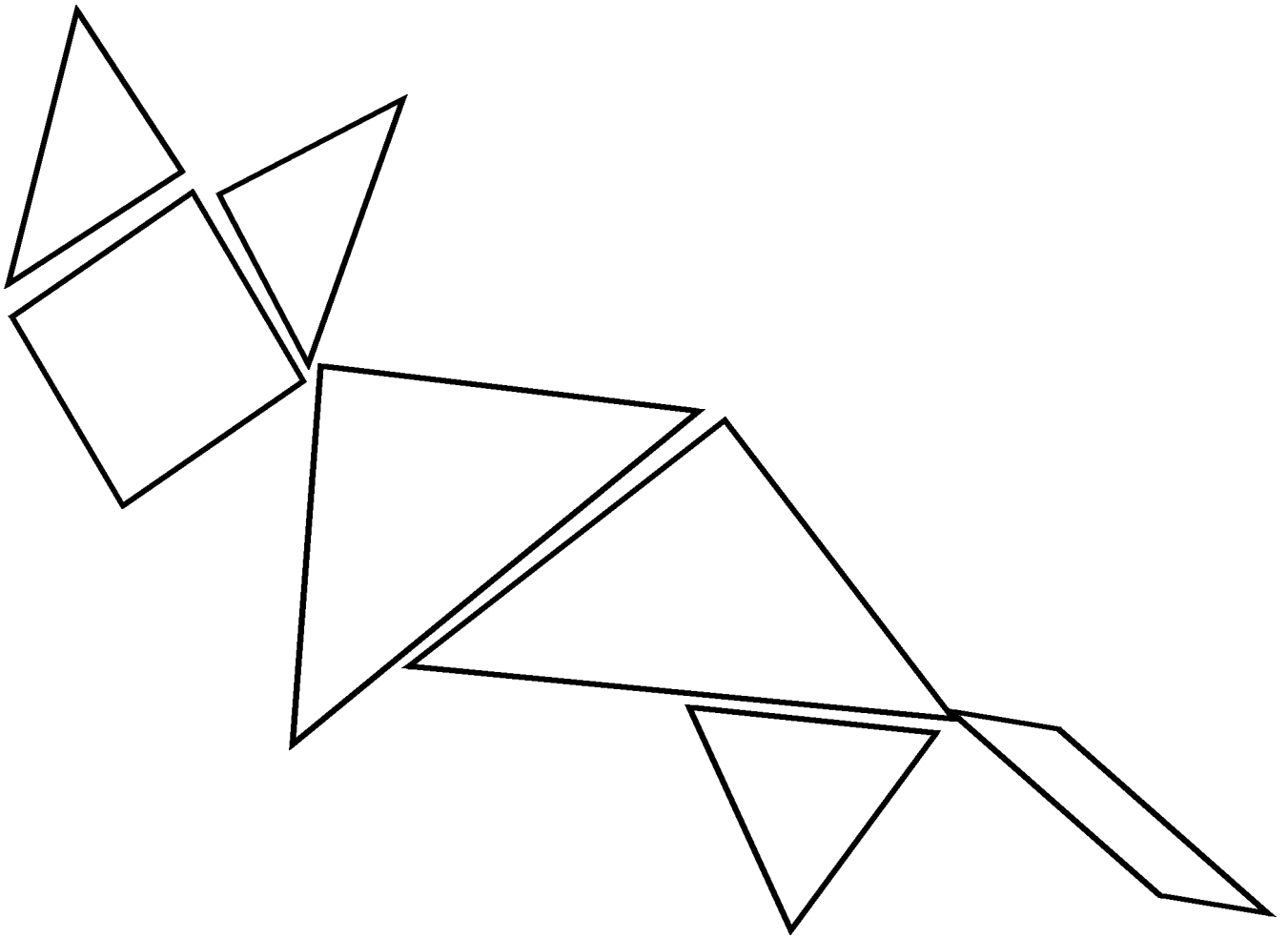


# Rabbit

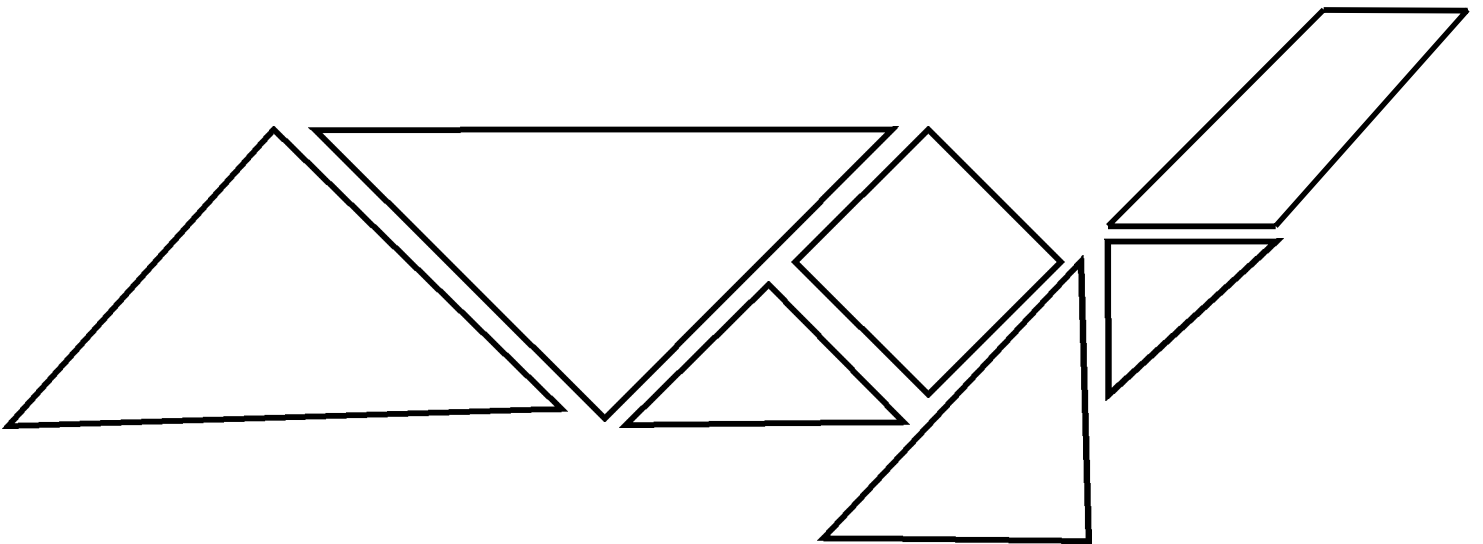


# Hawk



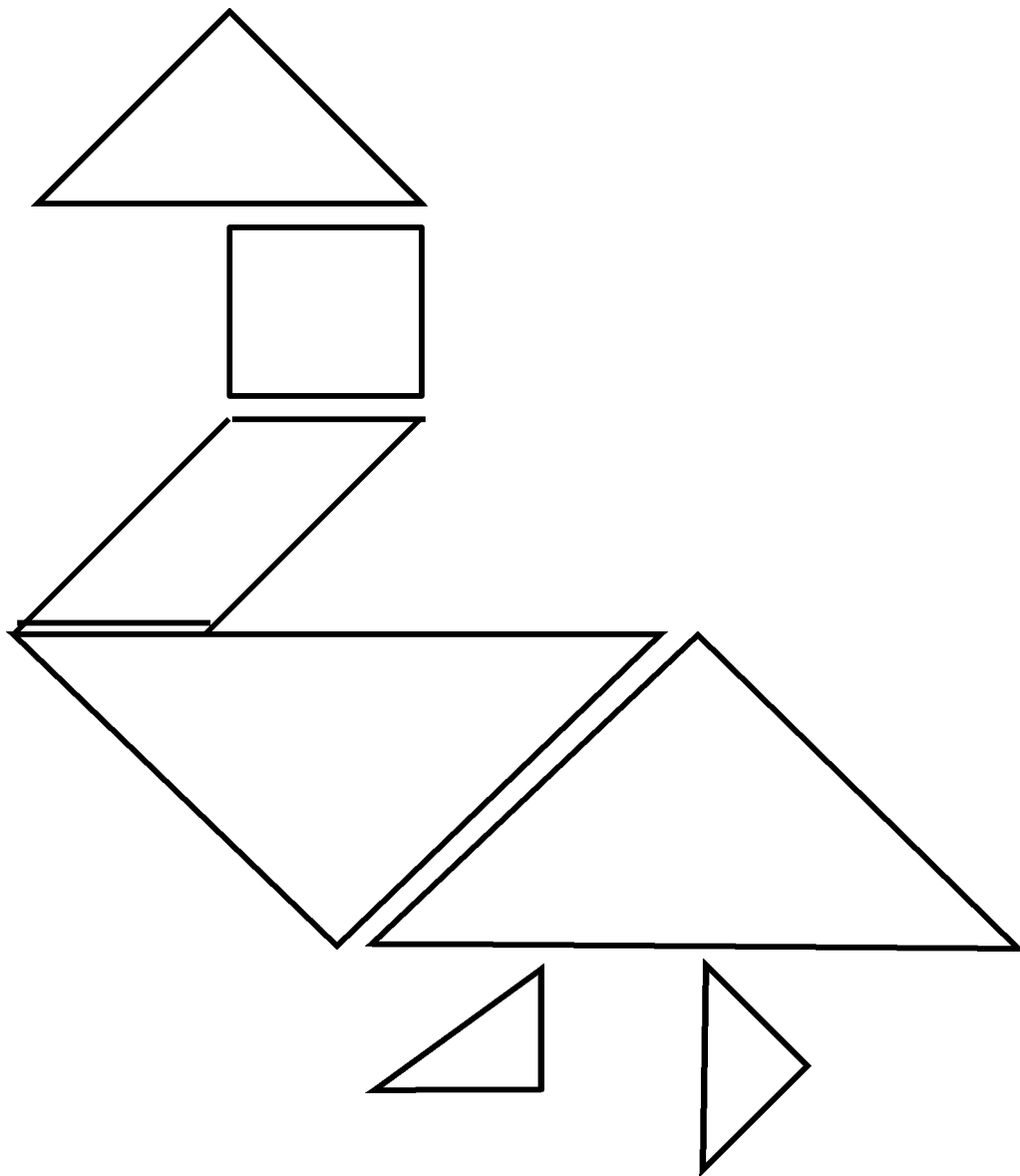


Fox Fairy



Turtle





Goose

# Tantalizing Tangrams Performance Assessment

## Rubric for Math

Score	Criteria
3	Story contains a minimum of 3 tangram figures. Each figure is constructed using all seven pieces of the tangram.
2	Story contains a minimum of 2 tangram figures. Each figure is constructed using all seven pieces of the tangram.
1	Story contains a minimum of 1 tangram figure. The figure is constructed using all seven pieces of the tangram.
0	Story does not contain a tangram figure or figure(s). Figures do not contain all seven pieces of the tangram.

## Rubric for Story

Score	Criteria
3	Story contains a beginning, middle and end. Correct use of capitalization, punctuation and spelling. Sentence/paragraph structure is well developed.
2	Story contains a beginning, middle and end. Few errors in capitalization, punctuation, and spelling. Sentence/paragraph structure is developed.
1	Story does not contain a clear beginning, middle or end. Some errors in capitalization, punctuation, and spelling. Sentence/paragraph structure is poorly developed.
0	Incomplete story that does not have a clear beginning, middle or end. Many errors in capitalization, punctuation, and spelling. Sentence/paragraph structure is not, or poorly developed.